Vertebrate pests of groundnut and their control

IFTIKHAR HUSSAIN*, JOE E. BROOKS**, EJAZ AHMAD** AND SHAHID MUNIR*

Animals with a backbone are called vertebrates. Any animal becomes a pest if by reason of its food habits, population, size or disease harboring pro-pensities, it adversely affects man's resources and well being. The vertebrate pests are largely primary consumers and utilize the organic materials manufactured by plants.

Groundnut (*Arachis hypogea*) is one of the major oilseed crops grown in Pakistan. There is a long period during which the crop develops and matures before harvest. Damage to groundnut by vertebrate pests in Pakistan may begin as early as mid-July and continue to harvest three months later. This crop is particularly vulnerable to attack by vertebrate pests because of its long period of maturation and low density of plants per hectare makes it easy for one or several animals to damage and destroy large parts of fields, even in a period as short as two weeks.

VERTEBRATE PESTS OF GROUNDNUT

Seven species of vertebrate pests have been found infesting the groundnut fields, which are as follows:

* Lesser bandicoot rat (*Bandicota bengalensis*)
* Short-tailed mole rat (*Nesokia indica*)
* Indian gerbil (*Tatera indica*)
* Indian crested porcupine (*Hystrix indica*)
* Wild boar (*Sus scrofa*)
* Desert hare (*Lepus nigricollis*)
* The crows (*Corvus* species)

Extent of Losses

Vertebrate pest damage to groundnut in Pakistan was assessed by Vertebrate Pest Control Project (VPCP), Islamabad at harvest in 1986 in four districts, i.e. Rawalpindi, Attock, Chakwal and Jhelum. Overall damage in the fields was estimated at 5.3 percent of which the lesser bandicoot rat accounted for 2.4 percent, the short-tailed mole rat caused 1.0 percent and the wild boar caused 0.9 percent. Desert hare, porcupine and crows together accounted for the remaining 1.0 percent damage. A recent study by BARD project has revealed that 77 percent farmers realize that rodent pests are a problem while 23 percent consider it serious. The yield loss due to rats is about 17 percent.

Pests and Damage Pattern

Lesser Bandicoot Rat

It is perhaps the most common field rat found in Pakistan. It occurs in lower Sindh, over most of the Punjab and North-West Frontier Province. It likes both irrigated farmland and moisture barani areas. The bandicoot rat damages a variety of crops, including wheat, rice, sugarcane and groundnut. It is a medium-sized dark brownish-grey coloured rat with nearly bare tail, slightly shorter than the head and body (Fig. 1).

Fig. 1. The lesser bandicoot rat

It lives in burrows and is solitary in habit. In Sindh, it breeds throughout the year. In central Punjab breeding stops during December-January while in northern Punjab, there is no

*Vertebrate Pest Control Laboratory, National Agricultural Research Centre, Islamabad

**GOP/USAID/DWRC Vertebrate Pest Control Project, National Agricultural Research Centre, Islamabad

breeding from November through February. Average litter size is 7.4 and one female can produce 10.2 litters annually.

In groundnut crop, the bandicoot rats live in burrows in the bunds and invade the fields when the monsoon rains slacken. But, because they travel as much above ground as below, their mounds could occur anywhere. In practice, however, they generally stay near the bunds and construct mounds in clusters. The lesser bandicoot rats tend to move away from the bunds and into the fields up to 28 m. Their mounds are characterized by the larger soil particles, open burrows, visible runways, empty groundnut shells scattered about in the area, and spindle-shaped fecal droppings. Mostly, the bandicoots have burrows under groundnut plants and simply remove the nuts without killing the plants. Bandicoot rats do not occur throughout the groundnut growing areas; they are confined to the northern and eastern parts of the country that receive more rainfall and have more loam in the soils.

Short-Tailed Mole Rat

It is a medium-sized rat similar to the bandicoot but with a short tail (Fig. 2). Breeding activity appears to continue throughout the year. Average embryonic litter size is 2.4 per female and one female can produce 6.4 litters per year. It spends most of its time in underground tunnels and burrows, rarely venturing above ground. It feeds extensively upon plant roots, bulbs and tubers but is known to damage nursery trees sugarcane, root crops, wheat, rice and groundnut.

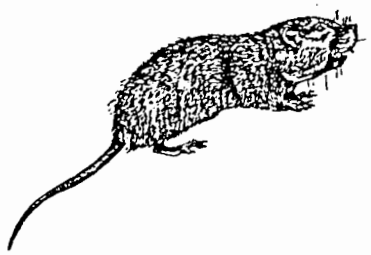

Fig. 2. The short-tailed mole rat

Mole rats tend to live in the grass- and weed-covered bunds from which they invade the fields by tunneling outward, leaving a trail of burrow mounds as evidence of their presence. A survey report showed that 42 percent of their burrows counted were within 1 m of the bunds and 65 percent were within no more than 5 m into the fields. The burrow mounds tend to be clumped, with as many as 20 to 30 mounds within an area of 25 to 50 m^2.

Mole rats damage the groundnut crop either by eating the roots, which kills the plants, or by eating the nuts only, which leaves a live but unproductive plant behind. The burrow mounds rarely contain any eaten and empty shells of groundnut. The mole rat burrows can be differentiated from bandicoot rat mounds by their generally smaller soil particles pushed up from the tunnels and by the more capsule-shaped fecal droppings mixed into the soil.

Indian Gerbil

It is a medium-sized rat with rather long hind legs (Fig. 3). The back is sandy-brown and the belly is white. The tail is hairy, with long tufts near the end and with a lateral light-coloured band running down each side of the tail. The gerbil breeds throughout the year except during the colder months. Average litter size is 6.8 and an animal can produce 7 litters per year.

Fig. 3. The Indian gerbil

The Indian gerbil is found throughout Pakistan except in sand dunes and rocky mountains. It is known to damage wheat, sugarcane, rice and groundnut crops.

Mostly, this species is not found in abundance in groundnut crop and damages only the individual plants under which it

litters during the period up to October. The average litter size is 5. The desert hare is a minor pest of groundnut.

Fig. 6. The desert hare

Hare does not damage the plants or roots but instead remove the nuts by pawing a shallow digging around the plant. It opens the shells much like rats, leaving empty shells scattered among the plants. Hare damage occurs throughout the fields. Fecal droppings in the fields are usually the clue of desert hare's visit.

Crows

House crows are found throughout Pakistan, commonly seen in cities, towns and in the countryside. The Asian or jungle crow (Fig. 7) is migratory through Pakistan, arriving in the lower plains following the beginning of the cool season in the higher mountains. At this time, it is pest of groundnut in *barani* areas of Punjab.

Both the house crow (*Corvus splendens*) and the mountain or jungle crow (*C. macrorhynchos*), generally cause damage in sandy areas where it is easy for it to pluck the groundnut from the soil with its beak. It usually does not dig more than 2 to 5 cm in the soil. Once it removes a nut, it makes a small hole at one side and extract the nut without completely opening the shell. Shells in many cases remain attached to the plant. Crow can cause severe damage in sandy fields because it feeds in flocks; each crow can eat the groundnut from more than 20 plants in a few hours. Crow damage can be seen throughout fields. Jungle crow normally does not descend to the plains until the first onset of cold weather, at which time most of the groundnut crop is already harvested.

Fig. 7. The jungle crow

CONTROL MEASURES

Cultural Methods

Clean farming practices discourage rodent infestations and make it easier to detect and deal with the menace when it occurs. On arable land, it is advisable to eliminate cover by clearing nearby uncultivated areas of weeds or bushes, including field edge habitats and the banks of water courses. Field edge habitats for rats may also be eliminated by consolidating small fields into larger cultivated tracts. Efficient weed control during the growing season discourages the development of rat infestation. In the post-harvest period, it is important to eliminate crop trash, for example, by burning and to plough the field as soon as possible to disrupt any residual food supply left in the field.

For example, farmers should practice weed and grass control on the bunds and in the fields of groundnut to eliminate or reduce the food and cover. Both the lesser bandicoot and short-tailed mole rat feed on roots, tubers and rhizomes of grasses and weeds growing on bunds. The rhizomes of Johnson's grass (*Sorghum halepense*) and *Desmostachya bipinnata* are subsistence foods of both species of rats all the year round, especially during the inter-crop periods. Elimination of these weeds would help to reduce the rodent population infesting groundnut fields.

Sometimes, damage from migratory birds (Jungle crow) can be reduced or avoided by planting and harvesting the crop early. The adaptation of groundnut

burrows. Nuts are removed but usually the plant is not damaged. Eaten groundnut looks like that of any other rat-gnawed shell.

Indian Crested Porcupine

It is a rodent although it looks considerably different from rat or mouse. It is easily recognized by the back being covered with long hollow quills which are barred in black and white (Fig.4). The porcupine is a slow breeder. It litters once or at the most twice in a year and a litter generally consists of 2-4 young. Adult weighs up to 18 kg. Normally, porcupine lives in family groups sharing one very extensive and deep burrow system which, if undisturbed, will be continuously occupied for many years.

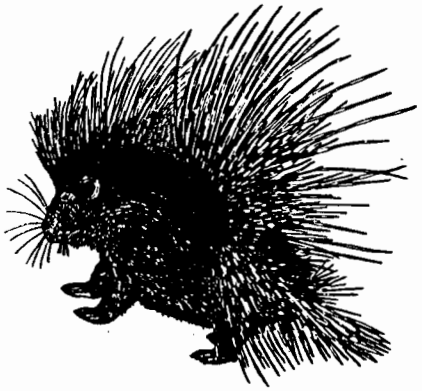

Fig. 4. The Indian crested porcupine

The porcupine damages and kills the plants by clawing the groundnut from under the roots. The damage extends into the soil about 2.5 to 7 cm, leaving loose soil under the plant, or an extracted plant. Intact, partially consumed, and empty groundnut shells are scattered about the clawed area. Damage usually occurs to a series of plants in a limited area, such as near a field edge, and as many as 30 to 40 plants may be damaged in one night. The presence of porcupine is determined from its footprints, shed quills, fecal droppings and nearby burrow openings.

Wild Boar

It is an important pest of crops in both barani and irrigated croplands. The animal has a very short thick neck, deep body and rather slender legs. The head has a long sloping muzzle, terminating in a special flattened disk (Fig. 5).

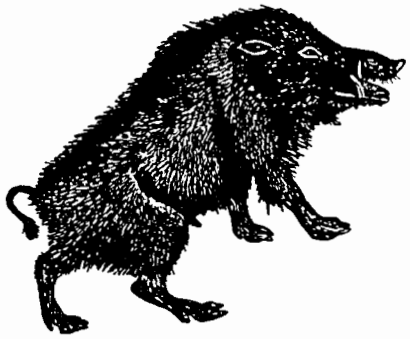

Fig. 5. The wild boar

The body is covered with coarse black and brown bristles. The male is usually larger than female. Breeding extends from February through September. The average litter size is 5.7.

Wild boar damages a variety of field crops, of which the most important are sugarcane and maize, but also includes wheat, rice, potato, sweet potato, groundnut, clover, chilli, peas and watermelon.

The wild boar roots out groundnut from under the plant, generally scooping out a depression from 5 to 10 cm deep and as much as 30 to 40 cm in diameter. Very few empty groundnut shells are found since the wild boar generally eats both shells and nuts. It prefers nuts when they are soft and sweet. Wild boar damage is more intense in the earlier crop cycles and slackens as the nut matures. The trail of wild boar damage could often be followed from plant to plant through a field. Sometimes on the plants, roots are exposed and the plants are withered or dead and sometimes the nuts are removed but the plants are otherwise uninjured. One boar can damage up to 65 plants in one night. Wild boar presence can be identified easily by its tracks.

Desert Hare

It is found throughout the drier areas of the Indus valley and the *barani* areas of the Punjab and NWFP. It is a large greyish-brown animal with long well-developed ears and a short tail (Fig. 6).

The hind legs are elongated for a speedy bounding gait while running. It starts breeding in March and can produce three

varieties with a shorter growing period (120-140 days) could reduce the time during which the plants are vulnerable to attack. With one exception, the varieties planted in July are harvested in late October and early November. The mountain crow could be a serious pest of these monsoon planted varieties. Planting of the crop near groves of the trees or tree rows around fields often will lead to increased attack of the birds. So, the crop should be planted well away from the trees, if possible.

Rat Control

Trapping

Because of large areas involved for effective crop protection, control of field rats by trapping is very expensive unless the area to be protected is small. Many traps would be required and they would need daily attention. Also, conventional type traps (Fig. 8) only work on those rats which feed on the surface.

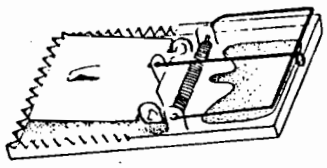

Fig 8. The conventional snap trap

One major rodent pest, the short-tailed mole rat, seldom moves about on the ground surface, inflicting mainly subterranean damage. The other main species, the bandicoot rat also spends much of its time underground, especially when the crop cover is less. It cannot be controlled, therefore, by conventional surface trap. Unfortunately, special mole or gopher-type traps (Fig. 9) which is effective is not available in Pakistan. But it can be prepared by special order. This type of trap is placed inside the fresh burrow opening. If possible, "flag the trap". This can be done by tying a scrap of cloth on a piece of vegetation near the trap.

The snap trap should be placed off paths or trails so that men or domestic animals may not stop on it. Set the trap near rat holes or rat runways. The trap bait has to be more attractive than the crop being protected. Replenish the bait daily and change the kind of bait after one or two days if acceptance is poor.

Chemical Control

Two kinds of rodenticides are available in Pakistan, zinc phosphide which is a blackish powder and smells strongly of garlic, and racumin, a product containing coumatetralyl, which is odourless and tasteless. Zinc phosphide is an acute poison while racumin is known as a chronic poison which is slow acting and causes death through internal bleeding by a process which inhibits the natural blood clotting mechanism.

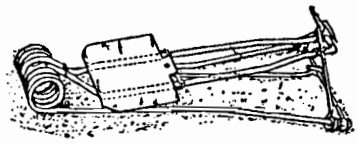

Fig. 9. The gopher trap

Calculating the Bait Formula

While using concentrates, the rule to remember is to divide the percentage of the concentrate by the final concentration desired. The answer obtained will be total number of parts of bait ingredients needed. Simply subtract one part for the concentrate and remainder will be the bait ingredients.

Examples:

i) Zinc phosphide (being marketed in Pakistan as 80 percent)

Required bait concentration = 2 percent,

80/2 = 40

Mix one part concentrate with 39 parts bait materials.

ii) Racumin, a 0.75 percent concentrate, final mix to contain 0.0375 percent,

0.75/0.0375 = 20

Mix one part concentrate with 19 parts bait materials.

Methods of Bait Preparation

A sample formula to prepare 5 kg zinc phosphide (2 percent) rat cake bait is as follows:

2.387 kg flour
2.387 kg broken rice or cracked corn
100 gm edible oil
125 gm zinc phosphide
Plus enough water to make a stiff dough.

* In a clean container, bucket or mixer, place the flour and grain and mix well.
* Add the zinc phosphide to the mixed dry ingredients, mix until the mixture is an even grey color.
* Add the edible oil and mix well.
* Slowly add water and mix until a stiff batter is formed.
* Place the bait on a smooth surface and roll flat till one centimeter thick. A wooden form and a piece of pipe or round wood can be used to ensure rapid rolling and uniform thickness.
* Using a knife, cut the flattened bait into squares about the size of one centimeter.
* Place in the sun to dry turning occasionally. Protect from dew and rain.
* Store in dry place by packing in plastic bags.

The sequence of mixing the bait is very important. Zinc phosphide reacts slowly with water to release the poison gas, phosphine. By adding oil to the dry grain and zinc phosphide mix, the oil coats the zinc phosphide particles and reduces the water contact with the poison.

Racumin: To prepare a racumin bait, use fairly clean broken rice, cracked wheat or cracked maize. Place 19 parts of the grain in a clean container for mixing. Add just enough edible or cooking oil to lightly coat the grain. When the two are mixed, start stirring while slowly adding one part of the racumin master mix, a light blue powder. Mix till the grain is evenly coated.

Baiting Techniques: Timing of rat control efforts is very important so as to get good control at a reasonable cost. Good rat control is based on prevention, not a cure of a severe problem. When the crop is damaged by rats, that portion of the crop is lost and control measures do not bring it back. Controlling rats before the reproductive stage of the plant brings substantial increase in yield, for example before the peg formation in the case of groundnut. The best time to strike at the rats is when they are few in number. This moment occurs shortly after a crop is planted. This holds good for groundnut also.

At this time, whenever an active burrow is located, place one or two pieces of zinc phosphide cake bait just inside the open hole. If the burrows are closed, as in case of mole rats and sometimes bandicoot rats, open the burrows, before baiting. Do not fill in the hole after placement of bait. Bait for two to four days and rebait the holes This procedure may kill up to 80 percent of the rats if the bait is used properly. Do not use zinc phosphide bait when it is raining or the rain is forecast for next day or the soil is wet or muddy. After two or three feedings on zinc phosphide bait, the rats that are not killed will no longer touch the bait, as the knowledge is somehow shared with others and new-born rats in the same area. This is called bait shyness.

When zinc phosphide bait is ineffective, the chronic poison or anti-coagulant such as racumin can be used. Generally, this bait is placed inside the fresh and open burrows with the help of some spoon. The baiting should be done for one week continuously. Beside baiting directly into burrow openings, the bait can be used in polythene bags or in PVC pipe bait stations.

Broken rice bait is packed in polythene bags, 100 gm per packet. One packet is placed in the midst of several burrow mounds (usually bandicoot rat construct 4 to 15 mounds per burrow system, average is 6), and these are found to have disappeared overnight. The rats pull themselves into their burrows and feed on the contents over several days. Bandicoot rats plug some of their burrow openings during the daytime but do venture out at night and can be baited by placing bait

packets near burrow opening or burrow mounds.

Cut the PVC pipe (7.5 cm diameter) into 40 cm length and plug one end with concrete. Place these pipes along ditches, bunds, inside the crop or any other areas where rat infestation is chronic. Originally place about 250 gm of broken rice bait of racumin and rebait as needed every two weeks.

Fumigation: Some rodent species are difficult to attract to bait placed on the surface of the ground due to their subterranean habits. Burrow fumigation is the most effective control method for pests like short-tailed mole rat and porcupine. Mole rat burrows are easily located by the presence of loose mounds of granulated soil which have been pushed to the surface by the rats. A good practice is to level all mole rat mounds the day before fumigation and examine them early next morning for signs of fresh activities. If only fresh or active burrows are fumigated, this will reduce cost and time.

Detia or phostoxin (aluminum phosphide) tablets are available to kill rats by fumigation in their burrows. Aluminum phosphide tablets require no elaborate equipment to use. One tablet is shaken out of the tin tube onto a teaspoon which should be tied on to a long straight stick. The long handled spoon can then be used to insert the tablet well inside the rat's burrow or tunnel. In wet or damp soils, the tablets work well. The tablets are placed in open burrows which are then plugged with grass or leaves, and afterward are sealed with soil. Check after one to two days and fumigate those burrows which are still active.

Porcupine Control

Before taking up any operational control measure against porcupine, survey must be carried out to map out exact location of porcupine dens. Because porcupine leave conspicuous foot tracks, characteristically shaped elongated droppings (faecal pellets) and frequently shed quills, so most of the farmers have no difficulty in locating occupied porcupine burrows.

Baiting

Vertebrate Pest Control Laboratory (VPCL), Karachi, conducted some trials using potato and apple as bait base and sodium monoflouroacetate (1080) as toxicant which result in a quick kill. A very small quantity of this poison is smeared on cut potatoe and apple with the help of thin stick and then placed deep into the burrow in the evening. The operator must wear the rubber gloves while using this poison.

Anti-coagulants such as racumin can be used for porcupine control. The racumin bait (0.0375 percent) is prepared by mixing one part of 0.75 percent concentrate of racumin in 19 parts of wheat flour. Add 2 percent gur or brown sugar as an attractant. Add sufficient water to make the dough. Make about 50-70 gm dough balls and place in active dens. Sustained baiting for about five to seven nights gives good result. Before placing the bait balls into the burrows, dust them with full cream milk powder. This increases their palatability.

Similar type of bait (0.03 percent) can be prepared of 1080 poison. To prepare 1 kg bait, 980 g wheat flour, 300 mg toxicant and 20 g molasses are required. Same method of bait preparation and application is recommended.

Fumigation

Another method of porcupine control is fumigation with Detia or Phostoxine tablets. Place 10-15 tablets in active den with the help of long-handled shovel. The opening is then packed with brushwood or vegetation and sealed firmly with dirt. A new burrow or one in hard stony soil require only 5-10 tablets while an old and deep burrow needs 15.

A two-ingredient pyrotechnic device has been successfully evaluated in Pakistan. This device is simply a gas cartridge containing 65 percent by weight of sodium nitrate and 35 percent ground charcoal. Devices weighing 200-250 g of ingredient can give 80-95 percent reduction in activity. After igniting, the

device is placed deep into the burrow. The burrow is sealed with brushwood and dirt. As a result of burning, carbon monoxide is released which kills the animal.

Wild Boar Control

Physical Methods

Physical control methods involve hunting and trapping. Among these hunting is the most common. It is direct removal of the animals from the area by killing. Hunting may be carried out with the help of dogs, especially during day-time. Quite often, wild boars are shooted at night, either on foot or more frequently from vehicles with the use of search lights. Since wild boars are usually nocturnal, night-time shooting offers a better chance of a kill. Trapping has been of only limited success and the economics are questionable. Use of steel jaw traps give some success.

Chemical Control

The baiting programme should be started at a time when the pigs are living in stressful situation looking for food and water.

Acute Poison: Sodium monofluoroacetate has been used successfully by VPCL, Karachi. Start the control with unpoisoned baits and this pre-baiting should continue for a period varying from four to fourteen days. This depends upon seasonal conditions and availability of natural food. Lay the poison bait (0.03 percent) [wheat grains + 2 percent molasses] when maximum consumption level of pre-baiting is reached i.e. when all the pigs are drawn out from their hideouts in the target area. Use the same bait base by which the pre-baiting has been done.

Chronic Poison: The anticoagulant rodenticide, coumatetralyl (racumin) is a good alternative of acute poison. The bait concentration should be 0.0375 percent. Mix one part of 0.75 percent racumin concentrate with 19 parts wheat flour. Add 2 percent molasses (brown sugar) and enough water to make dough. Separate the dough masses and roll them into small balls, each weighing about 80 to 100 gm. Before placing these balls on the field, dust them with full cream milk powder as an attractant. There is no need of pre-baiting.

Place the bait balls during the late afternoon where wild boar activity is evident, i.e. wallows, rooting of grass tubers, crop damage, numerous foot prints, etc. Start with an initial placement of 5-10 bait balls per site. Adjust their setting every night according to the previous night's bait take. The ground around each set should be cleared and smoothed so that the footprints could easily be read in the next morning. The uneaten bait ball should be retrieved early each morning and add back into the fresh baits prepared for the next night. Increase the quantity of the bait as the consumption increases. Baiting should be continued till the bait take is dropped to considerable level. It has been observed that the animals start bleeding after about seventh day of baiting start and mortality can occur from eight to tenth day.

Another kind of bait base, whole wheat grain, can also be used effectively. The final concentration of the bait should remain the same (0.0375 percent). In this bait, 4 percent crude sugar (*shakkar*) and 1 percent vegetable oil is added as an attractant and binder. The wheat grain bait is placed in 90 x 30 x 30 cm (L x W x D, approximately) ditches. These ditches or bait stations are made in an area of heavy wild boar activity. Each bait station is initially filled by 5 kg of bait. The area around each bait station is smoothed daily to check animal visits from footprints. The bait is replenished as needed and quantity could be increased with consumption. Baiting is continued until wild boar visits cease. Each bait station should be covered by an empty bag early in the morning and removed by late evening.

Desert Hare Control

Shooting

Damage may be suppressed or eliminated by shooting, where it is safe to do so. Effective control can be achieved, using a spotlight at night when hunting.

Exclusion

It is most often accomplished by the construction of fences

around the area to be protected. Woven wires of poultry netting should exclude all desert hare from the area to be protected. To be effective, the fence must be of mesh not greater than 4 cm, 75 to 90 cm high, with the bottom 15 cm turned outward and buried at least 15 cm below ground level. Exclusion by fencing is desirable for small areas of high value crops but most often impractical and too expensive for large acreage of farmland.

Poison

Both types of poisons, i.e. acute and chronic, can be used. Zinc phosphide (2 percent) or racumin (0.005 percent) can be applied on some baits. The best bait is carrot cubes but green leaves are also acceptable. Prebaiting can be done which should be done between the field being damaged and fields where the hare normally live. Place prebait and bait around the edge of the field being damaged. Place one to three kg of bait in areas visited by hares. Check the bait daily and add it as needed. A single feeding of zinc phosphide will control the hares. Anticoagulant bait must be eaten in five or more successive days. The bait should not be scattered in the crop.

Crow Control

Usually, a variety of techniques are needed to deter birds from feeding on crops, as a single method alone is not effective. No toxicant and repellent is registered in Pakistan for bird control. Generally, the use of chemicals under the prevailing conditions is not recommended because they offer the most environmentally harmful tactic and are expensive. The other limitation is that crows diet does include large number of insects considered harmful to agriculture, besides mice and carrion.

Scaring Devices Exploders: The exploder produces a loud explosion at fixed intervals, and has been used in variety of bird problems. To be effective, this device must be moved often, preferable every two to three days and regular maintenance is needed for proper function. To project the sound over a larger area, the exploder may be mounted on a platform or tower, change the time interval between explosions to prevent birds from becoming accus-tomed to the exploder.

Scarecrow: It is one of the oldest control device and, if used properly, can be fairly effective. The larger the number used, the better. The scarecrow may be made from a variety of materials, old clothing, grain sacks stuffed with straw, or a black plastic flag hung from a tall pole. The important thing is that it moves or swings in the wind like the exploders, it is important that the scarecrow should be moved every two or three days.

Reflective Tape: The reflective tape is an elastic, transparent, synthetic resin film to which a silver metal layer is applied by vapor deposition, then coated with a colored synthetic resin. In Pakistan, the local-made tape is available. These tapes are used at wedding ceremonies for decoration of cars, rooms and mosques on the eve of Islamic festival occasions.

The tape reflects sunlight to produce a flashing effect and stretched, it pulsates and produces a loud, humming, or sometimes thunder-like noise in the wind. These tapes are errected with sticks in the field in straigt lines about 3 m apart and at a height of 50 cm above the ground.